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THE STORY OF AIRCRAFT ENGINES—PAGE THREE

WSE MEETINGS—PAGE TWO

Vol. 6 DECEMBER, 1953 No. 7

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COVER STORY

The picture on the front cover of this December issue represents a happening which took place nearly 2000 years ago. The picture shows the first Christmas.

December 8, Bridge and Structural Engineering Section

Speaker: Dr. Ralph B. Peck, assistant professor of soil mechanics, University of Illinois.

Subject: "Stability of Bridge Abutments on Clay." Dr. Peck is the coauthor of a book on soil mechanics, and has had a great deal of experience along that line. He will use slides to illustrate his talk.

December 8, Junior Division

Speaker: John Roach, chief structural engineer, Naess and Murphy.

Subject: "Our New Neighbor to the East." Being with the firm which designed the new Prudential Building going up just east of the Western Society, Mr. Roach will be able to give his hearers a real insight into all that is involved.

December 9, Noon Luncheon Meeting

Speaker: James La Belle, Water Distribution Division, Department of Public Works, City of Chicago.

Subject: "Exposed Water Main for Fire Protection around the Prudential Building."

December 14, WSE General Program

Speaker: Alan Howard, manager of engineering, Turbine Division, General Electric Company.

Subject: "Progress in Electric Power Generation." Mr. Howard directed the original design and development of the world's first turbo-prop aircraft engine, and the first General Electric jet engines of the axial-flow type. Later he was in charge of the design and development of gas turbine power plants for locomotives, power generation, and other land applications.

December 16, Noon Luncheon Meeting

Speaker: Col. E. N. Wentworth, Armour's Livestock Bureau, Armour and Company.

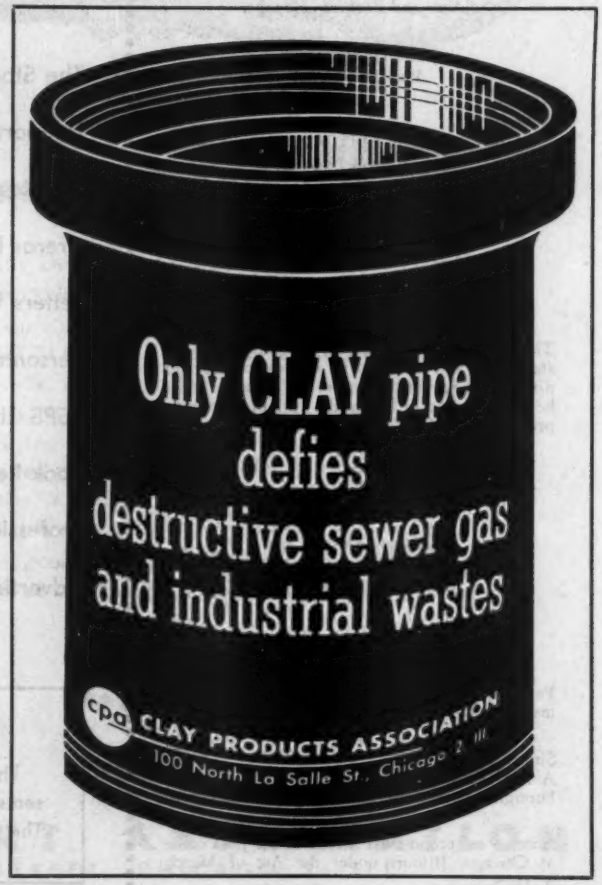
Subject: "Satisfying the Meat Consumer." Col. Wentworth is an authority on many phases of the meat industry, and has written a number of books on the subject.

December 21—January 1

No regular meetings scheduled due to the holiday season.

Merry Christmas
Happy New Year

Greetings to all members of the Western Society of Engineers, to their families, and to their friends. And may they be blessed with the best of everything to make their lives in the coming year more full, and the happiest ever.



Their first 50 years

The Story of Aircraft Engines

By O. T. Kreusser

In the late 1890's and the early 1900's mechanically minded people all over the world were applying combinations of mechanical power to transportation. America had its steam power and internal combustion engine inventor-mechanics who were enthusiastically applying their ideas and mechanisms to carriages, wagons, boats and bicycles. At that period the gasoline engine had reached the stage where the relationships between the piston, cylinder, valve, connecting rod and crankshaft were reasonably established. The work of the Europeans, Benz and Daimler, respectively, starting as early as 1885, by 1894 had already established the 4-cycle engine design so that automobiles in Berlin and Paris were in daily use in a luxury way. Their developments were carried forward by themselves and others into all forms of transportation, with particular publicity emphasis on automobile racing and dirigible airships.

The airplane engine had its real beginning with the Wright Brothers' first flight with a power-driven airplane at Kitty Hawk, North Carolina, on December 17, 1903. The fact that a gasoline engine powered such an early flight is probably as important as proof that for the first time man had developed satisfactory control of the airplane's stability in powered flight. That accomplishment set the direction in which subsequent development work all over the world was oriented.

The Wright Brothers, as bicycle manufacturers, had the experience and background of being familiar with practical light weight structures which were flexible yet sturdy and dependable. They knew that a 15 to 25 pound bicycle, with pneumatic tires and ball bearings, was a rugged machine that would carry a heavy rider and be reliable for years of service.

When their general interest in gliding became their hobby in 1900, they supplied an open-minded approach that has become fundamental to all transport engineering, and particularly to aircraft, where weight and proportion, flexibility, rigidity and vibration became elements of new importance and engineering significance. They established the practice of searching out and making full use of all available scientific and published data. They set up bench and ground experiments that provided them the opportunity to personally check and make fact-finding experiments to verify the soundness of the data and establish the principles involved. The sand duned beach at North Carolina provided a reasonable source of steady wind velocity to carry out their experiments with kites and tethered and free gliders that indicated the need for more complete basic information and more accurate test methods. They initiated the first wind tunnel, which they improvised, where air foil shapes and contours could be studied with airflows at different velocities while measuring reactions. All of this they did while learning some of the important principles of balance and control under air-borne conditions. Thus, they were able to build into their flying machine sufficient stability to make a safe landing under control.

The Wright Brothers initiated another practice that has continued over the years in the aircraft industry. Being unable to find any gasoline engine builders willing to undertake the construction of an engine that would weigh not more than 10 pounds per horsepower, they designed and built their own engine. Using a known cylinder, piston and valve combination that had demonstrated satisfactory power in a single cylinder stationary installation and applying weight limitations to each detail part through material changes and stress redistribution in a 4-cylinder design, they achieved their objective. Upon actual test, they found the engine provided more power than they expected. That fact probably was of major importance in making their first flight successful because their airframe was heavier than they had originally planned, since they had increased the strength and area of the wing surface. The Wright Brothers, therefore, earned the credit for having built the first gasoline engine to successfully power a man-carrying airplane. That 4-cylinder engine weighed 200 pounds completely installed, including radiator, cooling water and fuel, and developed 16 horsepower. A subsequent Wright Brothers engine produced 30 horsepower and weighed 180 pounds.

Prior to the Wright Brothers' accomplishment, there were other significant experiments that had definite influence upon the design of our modern airplane engines. In 1898, Balzer, of New York City, a builder of gasoline engines for commercial usage, provided Professor Samuel Langley with a small, 3-cylinder, rotary air-cooled engine to be used in connection with his model "Airodrome" experiments which he was conducting at the instance of the War Department, to decide whether a heavier-than-air machine was a practical device. In one of Langley's experiments, a 13 foot scale model, powered with a small steam engine, did actually fly.

In 1902, Charles Manly, an engineer working directly for Langley, completed the design, construction and testing of a 5-cylinder, water-cooled, radial type of gasoline engine that developed over 52 horsepower and weighed only 192 pounds. This engine, while successful as a power plant, unfortunately did not have an opportunity to perform in Langley's unsuccessful man-carrying airplane. The machine was wrecked twice in 1903 before actual flight could be accomplished, and the entire project was abandoned as a failure. Manly's design and its unprecedented accomplishment of light weight unquestionably supplied

(Continued on Page 4)

O. T. Kreusser, assistant to the general manager, Allison Division, General Motors Corporation, Indianapolis, Ind., presented this talk before the Transportation Symposium of the Centennial of Engineering in Chicago in September, 1952. This talk is reprinted by permission of the Centennial of Engineering, the collected talks of the Centennial being available in bound form from the Museum of Science and Industry, Chicago.

(Continued from Page 3)

the starting point for the continued, though interrupted, development of radial gasoline engines for aircraft. The relatively large diameter frontal area and thin fore-and-aft section provided a strong structure and aided cooling the engine with a minimum amount of water. The water-cooled radial engine as a type gave way to air-cooled radial engines in order to eliminate the troublesome plumbing connections. Over the years, many sizes and designs of radial engines have been in use. In America, air-cooled radial type engines comprise the major proportion of reciprocating type engines in commercial and military usage today. In Europe, liquid-cooled in-line type and air-cooled radial type engines are both in general use.

The 10-year period immediately following the Wright Brothers' invention in 1903 developed many individual efforts to accomplish flight with heavier-than-air machines in all the nations of the world that had mechanical aptitude. During that period, Germany and France, and to a lesser degree Italy and England, had been more active than other nations in developing engines for airplanes for military usage. At the beginning of World War I, France with its air-cooled rotary and radial types and in-line and "V" water-cooled types, supplied the engines that were favorites of many Americans that flew in that war. Germany had practically standardized on 6-cylinder, in-line water-cooled type engines. Even though they were relatively heavy engines compared with others, the available facilities for manufacture and their apparent reliability justified their use by the German planners as the basic military equipment. England had in use a variety of liquid-cooled, in-line and "V" types of 4, 6 and 8-cylinder configurations and, also, an 8-cylinder, air-cooled "V" type engine. America had in use three designs of liquid-cooled 4, 6 and 8-cylinder in-line and two V-8 types. None of these engines were much under 3 pounds per horsepower in weight and only one exceeded 200 horsepower in maximum output. It must be remembered that during the period initiated by the first Wright Brothers' flight in 1903, through 1914, the total airplane deliveries in America, military and private types combined, did not exceed one hundred.

World War I, however, immediately emphasized the importance of airships and airplanes for military and naval purposes. This demand stimulated accelerated plans and engine development among all the mechanically minded nations of the world. The military advantages of superior airplanes became apparent and caused friend and foe to develop new power plants to meet the particular requirements of specialized airplanes.

An airplane engine does not operate at full power for its full lifetime. It must, however, provide full power operation to take the airplane off the ground and to obtain maximum rate of climb to a practical flight altitude. All of the early engines were unsupercharged and as higher altitudes were reached, the engines naturally operated at decreasing outputs. At 20,000 foot altitude, the air is practically half the density at sea-level and the lower atmospheric pressure has the same effect as operating at half power at sea-level.

The war demanded several entirely different types of aircraft which in turn demanded materially different engines, both as to size and characteristics. For instance, to intercept an enemy mission over home territory, a very fast and

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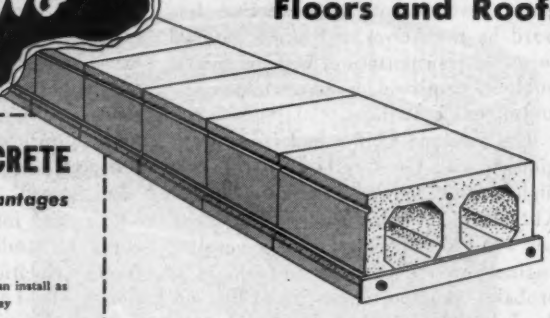

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small airplane capable of rapid maneuvering was required. It had to climb to high altitudes rapidly, with just enough military armament for one or two bursts of fire. Takeoffs usually were made from relatively small, widely dispersed airfields without smooth runways.

A different type of airplane was required for bombing. This machine had to be capable of long flights with heavy loads and capable of carrying sufficient fuel to return to its base. Good fuel and oil economy, reliability and engines capable of very high output during the take-off period were necessary for that type of airplane.

For reconnaissance observation work, a type of airplane was originally required that was capable of operating at high altitudes for sustained periods but not necessarily at high speed. This airplane required engines giving a combination of good horsepower and fuel economy at high altitude but with take-off characteristics just good enough to get out of the type of field available. With the improvement of photographic techniques, reconnaissance airplanes today are usually very high-speed machines.

World War I also demonstrated the need for larger and heavier airplane armament, as well as specialized types of aircraft that in turn demanded more powerful engines. By the time of the Armistice in 1918, American industry had produced 42,000 airplane engines of many different types, some of them of European design. A portion of this number of engines consisted of the Liberty 12-cylinder "V" type liquid-cooled engine which at that time was rated at 400 horsepower as the most powerful engine of its period. The Liberty was a design that permitted interchangeability of parts during assembly, thus providing large production volume with minimum of handicraft skills. Aircraft engine assembly practices prior to that time required highly skilled mechanics to fabricate and hand-fit the parts for each engine.

The usage to which the airplane is to be put influences, and oftentimes determines, the power plant or engine configuration. To obtain a particular type of performance, the engines must be tailored to that requirement. Likewise, for the airplane to provide the performance required, the availability of engines must be considered. In addition to the usage, the relationships of economics, such as first cost, ultimate life, operating costs, weight and size, that are applicable to all forms of transportation, must be considered. The airplane power plant must perform satisfactorily in a three dimensional environment, and furthermore, must be reliable in every regard in the variations of the environment that can radically change in a few moments time, from high temperature and sea-level conditions of a desert or cleared jungle land to the frigid and sterile but ionized conditions of high altitude. The success of any airplane mission depends largely upon the performance of the power plant in any and all phases of its operation, regardless of the temporary conditions of the environment.

It has often been said that any engine or power plant is a "package of horsepower," and that man's competitive urge continually demands more horsepower to meet and anticipate his needs. As an example, the military fighter airplane probably represents advanced trends that are typical:

In 1918, the latest fighter had 200 to 400 HP; in 1941 it had 650 to 1250 HP; in 1945 it had 2,000 to 3,500 HP; in 1950 at 375 MPH it had 5,000 HP; and in 1952 at 375 MPH it had 10,000 to 15,000 HP.

In this first 50 years of the aircraft engine's influence on aviation, there were many hundreds of designs and configurations of reciprocating, internal combustion engines that have actually been built. These efforts have been carried on simultaneously by all nations that possessed industrial facilities and had the mechanical "know-how" to be technically self-sufficient and to recognize the important place of aviation in military matters.

As an important secondary result of such intensive development of aircraft engines for military purposes, established designs and facilities and trained personnel were available for commercial usage. The same skills and experience that design and make military aircraft enable us to produce private and commercial transports, that make the most distant lands, when measured in miles, close neighbors when measured in time to get there by air.

While it is logical to consider that military airplanes can be of an "all purpose" type and thus get along with a minimum number of standardized and proven engine designs, it is a fact that such an airplane would be mediocre in all fields of activity and would meet specialized enemy aircraft under a handicap. To a lesser degree, that same factor applies to commercial airplanes where costs of operation, availability and facilities for their safe operation are important competitive factors. The tactical use to which an airplane is to be put determines the configuration, size, weight and type of airplane and engine.

In view of the high cost of designing, building and testing aircraft engines, and the relatively restricted markets available only after such engines complete their test programs successfully, the actual building and testing of aircraft engines have been most aggressive with government financial aid. Therefore, government assistance in the form of experimental orders for certain research developments, as allowable costs on government purchases, is a general practice. Such underwriting is advantageous to both government and industry because it usually insures that the newest and most suitable engine is developed and supplied for use in a much improved military airplane.

The most successful aircraft engine designs that have actually reached quantity production manufacture are those that were evolved from a practical basic design through the continuous improvement of detail design and in better control of material quality, improved fabrication methods, facilities, processes and testing. These improvements normally result from experience and "know-how" gained by an alert engine manufacturing organization from the production of current engines and, thus, provide the necessary ability to increase reliability and output, or improve altitude performance, with minimum increase in weight. In the 1000-horsepower and larger engine field, where extensive development work has been carried on over the past twenty years to meet required military performance and range needs, experience has shown that it takes five or more years for a new design or larger size of engine to reach the stage where it can be considered as having sufficient proven merit to be installed in an airplane and produced in quantity. This condition exists where basic facilities and personnel for de-

(Continued on Page 11)

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Any member of the Society may compete regardless of grade of membership.

Papers shall not be highly technical in nature. A clear, concise and interesting coverage is desired rather than complex formulae or derivations. The subject discussed should be of general interest to engineers but should not be of a political or highly controversial nature.

All members of the Society who wish to submit papers in this contest should contact the Secretary as early as possible and not later than February 1, 1954, and request a copy of the rules governing the competition and an outline of the minimum requirements for acceptance of papers. These cover in detail the mechanical make-up which should be followed in preparing and submitting papers for the contest.

Papers must be submitted to the Secretary for acceptance by April 1, 1954. If the Secretary finds that they meet the minimum requirements of the contest, he will forward them to the Awards Committee for review. The papers will be identified by number only. The Secretary of the Society is the only person who will maintain the key to the authors.

If any paper does not comply with such minimum requirements, the Secretary will so advise the author and discuss with him the points which are below the minimum requirements. The papers which are accepted will be forwarded to the Awards Committee for judging not later than May 1, 1954. Papers which have not met the minimum requirements by that time cannot be considered for prizes.

Papers which are accepted will be judged on originality of presentation, editorial merit and value to the engineering profession.

The papers submitted must not have been previously published in substantially the same form. No copyrighted materials shall be used unless permission has been obtained and so indicated. All manuscripts, drawings, etc., are to become the property of the Society and cannot be published without the consent of the Society.

If the papers submitted are NOT of sufficient merit to warrant the award of any or all of the prizes, the Awards Committee reserves the right to award less than the five established prizes or to postpone the competition.

The winners will be announced and the prizes presented at the annual meeting of the Society in June, 1954.

WSE Executive Secretary will furnish you with a complete set of rules and minimum requirements on request.

Heliports for Commercial Transportation

By John P. W. Vest

The preceding speakers have ably outlined and predicted the expected development of helicopter passenger transportation. I should like to point out that the helicopters will be entering a highly competitive field and that the predictions made will only be realized if they can offer positive advantages over their established competitors both in the air and on the ground.

Airplane speeds will always be higher and cost per seat mile lower than helicopters. The airplane's disadvantage in the short haul market is the airport-to-downtown time and cost, which largely nullify the greater air speed and lower seat mile costs. Ground transportation —train, bus, private automobile—operates from city center to city center and cost per seat mile will be lower than helicopters may hope to achieve. The helicopter's advantage over ground transportation will only be substantially greater speed and its advantage over the airplane could only be by operating between midtown terminals, thereby avoiding the airport to downtown delays. Therefore, a primary requirement for successful helicopter passenger operations is the establishment of suitable downtown heliports in adequate numbers. It is not putting it too strongly to say that until this is done, acceptable and competitive helicopter transportation will be just a dream. There is no point in flying a helicopter at 150 miles an hour between outlying airports in competition with airplanes which fly the same route more economically at 400 miles an hour. Generally speaking, heliports must be in the heart of the community served.

From the point of view of location, heliports may be considered in five general classifications:

1. Metropolitan mid city
2. Peripheral
3. Suburban and intermediate
4. Airports
5. Industrial and private

These various classes actually form an interdependent complex and mutually support each other. Wise planning by operators and public officials will treat them as a whole concept and plan accordingly, because the helicopter transportation system which is envisioned will require all types. Helicopters will not merely shuttle between mid-city and mid-city or between airports and downtown. There will also be transportation between suburbs and airports, between suburbs and downtown, and intermediate stops on the mid-city runs. However, the downtown city heliports will be the hub and key of the entire complex.

I am going to mention briefly the problems involved in establishing a heliport in a mid-city area of a large metropolitan district, because it is in such a location that these problems exist in their most exaggerated forms. The same problems, of course, will be encountered in other locations mentioned, but there they will be far less difficult of solution.

The problems that will be encountered fall under four general headings, that is, legal, public safety, noise and costs. Time will permit only a brief mention of each.

Reference elsewhere has been made to the existing flight regulations, federal, state and local, which will require modification to permit helicopter operations, particularly in the urban areas. In addition to these, practically all communities will need to re-examine their zoning laws and classifications to permit establishment of heliports in the necessary locations. Changes in zoning are notoriously difficult to achieve and require a great deal of time and public education. Further, where roof top or other structural heliports are indicated, modifications and revisions of city building codes will undoubtedly be required. I shall go into this latter aspect more thoroughly in a few minutes. It is evident that all of these legal changes will take some years to accomplish, and it is certainly none too early for those concerned to be giving very hard thought to the matter.

Public safety must be a paramount consideration in any form of transportation, and it is a particularly sensitive one in air transportation, where it involves safety not only for air passengers but equally for people on the ground. Within the past few years, controversies in the New York area over the location of airports such as Newark and LaGuardia have brought this latter consideration sharply into focus, and proposals to operate helicopters in and over densely populated city areas are bound to raise this question. The laws, regulations and ordinances governing aircraft are generally guided by the principle that no aircraft shall fly over populated areas in such a manner that loss of power will result in unduly endangering persons and property on the ground. This is a sound principle which should and undoubtedly will apply to helicopter operations.

All plans for such operations are being based on the premises of using multi-engine helicopters and such machines capable of continued flight with one engine out will certainly be available within the next three to five years.

This will, of course, greatly reduce the danger of forced landings. However, it would seem advisable, pending accumulation of more experience and development, that heliports should be so located that helicopters can fly between them and the city perimeter over access paths which will permit them to make forced landings if necessary without unduly endangering persons and property on the ground. I believe that this principle of "clear access" should apply to the heli-

(Continued on Page 8)

This address was presented before The American Society of Civil Engineers, Air Transport Division, at the Hotel Statler in New York City on Oct. 22, 1953. Mr. Vest is chairman, Heliport Committee, Helicopter Council, Aircraft Industries Association of America, Inc., Washington, D.C.

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port locations for at least the next ten years.

Desirable as it might be from the point of view of passenger generation and public convenience to locate a heliport, for example, on the roof of Grand Central Terminal in midtown Manhattan, this principle of clear access will probably preclude such locations at least for the initial period. Fortunately, this obstacle is not as unsurmountable as it first appears. A surprisingly large number of cities in the United States are located on waterways which pass very near the city centers and these waterways generally make excellent access paths for helicopter flight. Other possible access paths are parks, modern parkways, railways where not electrified, and industrial areas. In most cases, the use of one or a combination of such features will permit safe flight paths to be established very close to the optimum areas.

Another very serious objection to locating heliports in thickly populated districts will arise from noise. The noise level of our cities has been rising steadily and in recent years, public resentment and resistance against any additional noise has increased rapidly. Unfortunately, helicopters are noisy and will tend to become more so with increased size and horsepower and the introduction of newer power plants such as turbines and jets. The designers must and undoubtedly will do everything possible to reduce these noises, but the selection of a heliport site must give full consideration to the effect of noise in the area.

Last but certainly not least is the factor of cost. The same basic requirement that the heliport be located in or near the urban center insures that we will be dealing with high priced and highly taxed real estate. At the same time, the economics of helicopter operations make it mandatory that terminal costs be kept low. From these two conflicting considerations, one fact emerges clearly: the area occupied by the urban heliport must be kept to minimum dimensions.

This brings us to the vital question of size, dimensions and obstruction criteria. I am not going to attempt to go into various considerations which affect this question, nor can I be dogmatic as to the answers because no final determinations along this line have been reached by the industry, the operators or the C.A.A. However, it is necessary to draw your attention to certain characteristics of helicopter performance which are basic to the question.

Although the helicopter is capable of vertical ascent and descent (within certain limitations), and therefore can land on and take off from a platform only slightly larger than the diameter of its rotor blades, such performance is not acceptable for safe and economical routine operation. The vertical regime of flight requires the maximum power and therefore the minimum payload. This is clearly illustrated by the characteristic curve of power required vs. forward speed which shows the point of most efficient climb and, therefore, maximum payload capacity, occurs at roughly one-half the machine's top speed. Predictable transport helicopters would require up to 500 feet of horizontal flight to accelerate to this speed and under such conditions would carry maximum payload. This procedure, however, would result in a heliport size requirement which would be excessive and in urban locations self-defeating.

A compromise between these extremes will probably result in a take-off technique of climb-out at a speed somewhat lower on the curve which, though sacrificing some payload, will permit reaching a safe altitude to clear obstructions of reasonable height and also permit return to the landing mat in case of partial power loss. This take-off requirement will be the controlling consideration because the landing approach can be made safely at steeper angles of descent than the take-off.

These and other considerations indicate a probable requirement for the actual landing and take-off area of the following dimensions:

Length—Minimum 350/400 feet; optimum 450/500 feet; preferably oriented into the prevailing wind with obstacles at either end not higher than 30 feet.

Width—Minimum 300 feet between 30 foot obstructions.

Obstruction limitations—From edge of mat, long axis, approximately 15 degrees or 4 to 1 for the first 400 feet, 25 degrees or 2 to 1 out to 1,000 feet. Short axis, from center of landing area 15 degrees out to 500 feet.

I wish to stress that these are conservative and tentative conclusions and subject to modification with future developments of helicopter design and greater operating experience. The figures given should be used only as a guide in initial planning.

At this point, I would like to introduce a cautious note of optimism. We all know that the curse of airport planning for the past 25 years has been the fact that higher performance by planes has consistently required longer runways, so that airports and airport locations have been made obsolete by airplane developments almost as fast as they were built. In the case of helicopters, it appears that this will not occur. Peering ahead for the next 15 or 20 years, the indications are that the higher performing helicopters will not produce a corresponding demand for larger and less obstructed heliports. It is even possible that with improved performance, future requirements may be reduced. If true, this will be a factor of great significance in planning urban heliports in areas where expansion would not be practical.

The dimensions which I have been discussing are those required for actual operations, that is, landing and take-off only. Depending on the volume of traffic, additional space will be required for auxiliary functions, including loading, unloading and parking of helicopters, passenger accommodations and limited service facilities. Planning officials also emphasize that a busy heliport will create ground traffic problems and will probably require a certain amount of automobile parking space adjacent. Provisions for these areas on the same level as the operating area may add up to a total prohibitively large at the urban heliport designed to handle considerable traffic. One solution to this situation is the roof top or structural type of heliport in which the auxiliary space can be provided at lower levels.

Before considering requirements for structural heliports, it is necessary to take a quick look ahead to estimate weights and forces with which we will be dealing. Helicopters are currently entering a period of rapid growth and it would be extremely shortsighted to design structures for today's weights, only to become obsolete within a few years. Today's commercial helicopters are all below 10,000 pounds gross weight. Between now and 1960, there will be a

rapid growth in weight up to about 30,000 pounds gross and by 1965, it is quite possible that transports up to 45,000 pounds will come into service. Beyond this weight there is no design obstacle to continued increases, but it is the concensus of operators that the 50 to 60 passenger machine will be the largest size required. Therefore, as a planning figure for structures with a life extending 20 years or more, it appears reasonable to plan for helicopters up to 50,000 pounds gross weight.

For such weights as these, the roofs of most existing buildings are inadequately stressed and strengthening of the entire building would be required. It will probably be found more economical and satisfactory to look toward buildings originally designed for the purpose.. In these cases, the term "roof top" is really a misnomer and the description "structural heliport" is more appropriate.

For a variety of reasons, both structural and operational, excessive height in a structural heliport building is undesirable. Four to five floors—60 to 75 feet—appears to be the maximum. The top of the structure would be the operational area proper, entirely occupied by landing and take-off area, loading-unloading and service-parking spaces. The floor below might well contain passenger, baggage room-waiting room facilities. Below that, one or more levels of automobile parking spaces and, where appropriate, taxi and bus facilities at the ground level.

Strength and stress considerations for such a structure would be calculated as follows: given a tricycle landing gear of two main and one secondary wheels, it should be assumed that under extreme conditions the maximum impact load could be 3.5g, with no more than two-thirds of the total weight applied by any one wheel. This maximum impact should be taken as an ultimate yield point rather than the working load stress. As regards static load distribution, the following can be calculated for a typical 30,000 pound helicopter with two main and one tail wheels:

Each main wheel	13,250 lbs.
Tire flotation area	160 sq. in.
Tail wheel	3,500 lbs.
Tire flotation area	52 sq. in.
Main wheel span	20 ft.
Tail wheel span	35 ft.

It would be reasonable to assume that the pounds per square inch distribution with larger sizes would remain approximately the same with tire flotation area increasing proportionately to increased gross weight.

The landing and taxi area will require an adequate surfacing to withstand the wear and tear of opertions and protect the water tightness of the subsurface.

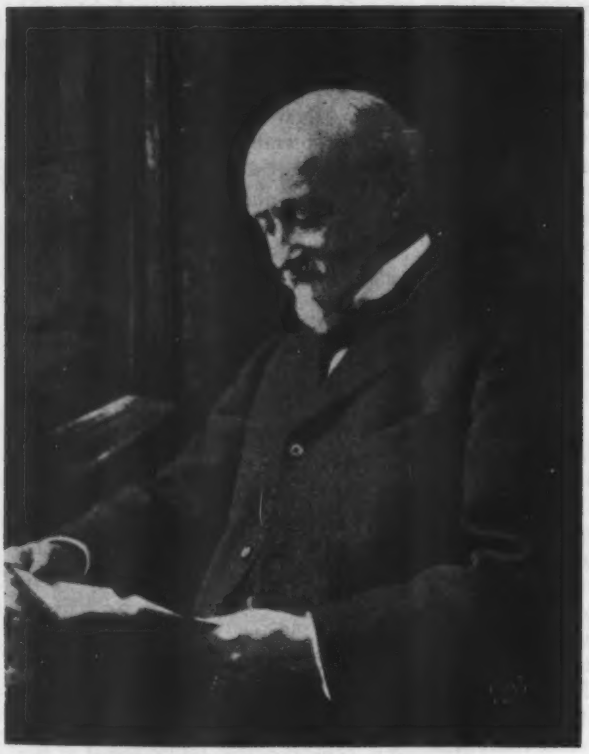
I mentioned earlier that where suitably located waterfront areas exist, these may often present the optimum access path. In such cases, it may also be found desirable for many reasons and structurally less expensive, to build the heliport operating area over water, either on pilings or possibly on a floating structure. Such structures would generally contain one, two or three levels with possibly some of the auxiliary facilities located on the adjacent shore. I believe the possibilities of such structures should be investigated carefully as it appears that considerable savings may be realized in such cases.

Turning to the suburban or other non-urban heliports, it will be found that in such cases it is generally possible to make these of the ground level type. Ground level heliports are certainly far more desirable in many respects and should be chosen whenever possible. A single and rather surprising exception to this rule is the case of major airports where all considerations point to the desirability of placing the heliport as a structural component of the main terminal building.

Before closing, I should like to emphasize just two points. It may seem that I have been talking about a rather expensive and elaborate dream design which will be very difficult to realize. I have no thought that such structures should be erected immediately nor in large numbers. Helicopter transportation will not come overnight nor spring full blown into its ultimate form. And for some years to come, I expect that we will do our operating out of much more modest facilities than I have been discussing. However, suitable transport helicopters are coming, probably sooner than is generally realized, and their value to the public is going to depend very largely on suitable terminal facilities. The type of urban heliport that I have been talking about is going to be required eventually and I do not believe that now is a bit too early to start thinking and planning seriously to make it possible.

Finally, it may seem that I have enlarged on the problems of establishing such a heliport to the point of pessimism. I do not want to leave such an impression. Certain problems do exist and they must be solved. There is no doubt in my mind that they will be solved and that their solution will be greatly expedited by recognizing and facing them at the very beginning.

Aviation Marks Its Golden Anniversary



Octave Chanute, former president, WSE

Just 50 years ago on the 17th of this month, Orville Wright, at Kitty Hawk, N. C., flew 120 feet in 12 seconds. He was the first human ever to be lifted into the air by a powered machine that was heavier than the air. That same day, Wilbur Wright, Orville's brother, flew over 800 feet, staying aloft one second less than a minute.

Members of the Western Society of Engineers should be especially interested in this golden jubilee of flying because Wilbur Wright, on the invitation of the Society's president, Octave Chanute, appeared before the Society in 1901 and gave an account of the experiments being made by him and his brother. He gave another talk before the Society in 1903.

Octave Chanute, president of the Western Society in 1901, and later elected an honorary member, helped pioneer in solving the "Problem of the Ages."

In 1889 when he moved to Chicago, Chanute took up seriously the question of flying. He corresponded extensively with men the world over who were interested in the problem. He made a great contribution by collecting and systematizing all the information he could find on the subject and publishing a series of articles on "Progress in Flying Machines."

Chanute, about this time, heard of Otto Lilienthal's successful glider flights near Berlin, Germany. This induced him to make a Lilienthal glider. Chanute made over 200 successful flights near the present site of Gary, Indiana. He greatly improved glider design, finally evolving a biplane, the prototype of the successful Wright plane. Chanute described his experiments in flying in a paper before the Western Society in 1897.

Chanute died in 1909. At that time, the Aero Club of Washington said, "Lilienthal, Chanute, Langley, and Maxim are the four names that will ever be inseparably linked with the early stages of flying-machine development, the stages that preceded the successful invention of the first man-carrying machine by the Wright brothers."

Wilbur Wright in "Aeronautics" paid Chanute the following tribute: "If he had not lived, the entire history of progress in flying would have been other that it has been, for he encouraged . . . the Wright Brothers to persevere in their experiments . . ."

Aircraft Engines

(Continued from Page 5)

sign development, test work and production manufacture are already in existence. Obviously, it is most difficult for an individual or group without such facilities to make progress as newcomers in the aircraft engine manufacturing field. During the elapsed time that a new engine development is underway, continual advances are made in the performance of aircraft engines already in active production to avoid obsolescence and to fulfill improvement requests of the customer. Similar advances cannot be made when only development engines are available for operation because test experience is then limited by insufficient hours of testing. Many such developments have lost out, even though original objectives have been met promptly because the new design lacked the necessary background of test experience to enable rapid modifications to meet new requirements. The history of aircraft engine design developments that had merit at the time of conception is full of abandoned projects because the clapsed time and changing economics caused cancellation.

All of the engines that were available for volume production in prosecution of the war were designed, tested and released for production prior to hostilities. The large production program of the war period, the extensive flight experience gained during that time and the continuous need to meet the enemy with equal but preferably superior equipment, provided excellent opportunities for improving all phases of a given aircraft. During World War II some aircraft engines doubled their horsepower output with equal or improved durability of the basic design and size of engine with but little increase in weight. An important factor of such improvement was the availability, in sufficient quantities, of fuels with anti-knock characteristics fitted to meet aircraft requirements, both for testing and actual training and combat flying in all areas.

In such intensive programs, involving generous numbers of test engines plus the extensive and current experience in the field, many different improvements are carried on simultaneously, and thus, out of any given period, sufficient gains are accomplished to justify such accelerated and costly testing. While the basic configuration and size of engines under such developments have not materially changed, the detail design and material specifications, as well as the processing methods, were profoundly affected in important ways.

It must be remembered that airplanes are not usually flown until the important components, such as engines and propellers and their numerous accessories, have actually been proof-tested and released as being reliable for flight under test conditons. This makes it necessary that power plants be developed and be far enough along as to availability to insure their approval and release for flight several months before the airframe is ready for flight. That difference in timing ofttimes controls and determines the particular engine that a certain airframe can consider in connection with meeting a scheduled date of delivery, particularly in prototype models.

Engines for aircraft are analyzed usually on the following factors which must be taken into consideration during design and evaluation of an airplane and later when the over-all economics and availability of the power plant for a particular design are considered.

A most important factor is the horsepower-weight ratio, which is the installed weight of an aircraft engine and its accessory equipment divided by the guaranteed take-off horsepower. This denominator describes the maximum horsepower which the engine builder is willing to guarantee to the customer on the basis of having actually operated the engine at that horsepower on the customer-observed acceptance test. A heavy engine for a given output is a handicap for all types of flying, and is justified only if a lighter engine of suitable configuration, durability and operation economics is not available.

Another factor is horsepower per cubic inch of displacement. This factor, applicable to reciprocating engines, is related to the horsepower-weight ratio insomuch as displacement, which is the combined volume in cubic inches of all the power cylinders of an engine, affects the size of the engine. It is the engine maximum horsepower divided by engine displacement.

Engines of large displacement usually weigh more than engines of small displacement of the same type and use more fuel for a given mission.

For turbo-jet engines, the horsepower to weight and horsepower to cubic inch displacement factors are not directly measurable. In place of these factors the turbo-jet engines are calibrated in "pounds, static thrust," and weight per pound of static thrust.

"Horsepower" is the engineer's measure of the rate of work, and is equal to lifting or moving 33,000 pounds one foot in one minute. There is no actual work being accomplished with jet propulsion until the jet is actually moving the vehicle in which it is installed. At 375 mph speed of the vehicle, one pound of thrust is equal to one horsepower. Therefore, a jet engine rated at 6000 pounds static thrust at sea-level, when installed in an airplane, will be developing approximately 6000 horsepower when the airplane is moving 375 mph. At that specific speed, where one pound of thrust equals one horsepower on the basis of 33,000 foot pounds per minute, the 6000 pounds of thrust of the engine would continue to accelerate the airplane to higher speeds. It so happens that a single engine airplane of typical high speed design will fly at a speed of over 600 miles per hour. At 10,000 feet, where both the airplane drag and engine thrust is less than at sea-level, the engine output is approximately 9100 horsepower when travelling at 600 miles per hour. Higher altitude pays off in permitting such high speeds at good fuel economy, which makes it most desirable to fly jet powered aircraft at the highest altitude that aerodynamic characteristics of the airplane and the safety and comfort of the pilot will permit. Altitudes of 50,000 feet and higher are desirable in fighter airplanes.

Jet engines rated at one horsepower per pound of thrust at 375 mph provide installed weights of less than ½ pound of engine weight per horsepower and, of course, when based on performance at the higher speeds, very much less. There is every reason to expect a continually lower figure as improved designs and larger engines are developed, as a result of the increasing development and operational experience with gas turbine engines. The use of more suitable materials, particularly reliable at high temperatures, will also improve the specific weight characteristics of current engines.

(Continued on Page 12)

(Continued from Page 11)

The factor of fuel consumption is important because the quantity of fuel carried determines the range and/or pay load of the airplane, and is defined as the actual fuel consumed per horsepower hour by reciprocating engines. It is usually the guaranteed consumption of a specified grade of fuel but careful engine operation during flight can improve the guaranteed figure. Fuel consumption during take-off operation of modern aircraft engines may be as low as .70 pounds of fuel per horsepower hour in the case of reciprocating engine and automatic constant speed propeller and an exhaust driven supercharger. Take-off consumption of a turbo-jet engine using an afterburner will be approximately three and one-half times that amount.

When compared under conditions that can be considered the equivalent of shaft horsepower, the turbo-jet fuel consumption is high at speeds under 500 mph and at the lower altitudes but is superior to propeller operation with reciprocating engines at speeds above 500 mph and at high altitudes. These extremes of fuel consumption characteristics in combination with speed, maximum rate of climb and altitude characteristics of the airplane, make each of these power plant types useful in providing a better airplane for a particular design category or mission, particularly in military aircraft.

The factor of frontal area represents cross sectional area of the engine and its accessories because the size and shape of the engine's cross section affect the drag or wind resistance of the airplane-engine combination. The larger the cross section the higher the drag, and in level flight the airplane engine's power is expended in overcoming the drag. Drag is an important factor where high speed flight is desired because thrust must be increased four times in order to double the level flight speed of a particular airplane design.

There are turbo-prop engines of small size and light weight that indicate take-off horsepower equal to good reciprocating practice but which have fifteen per cent better take-off fuel economy, or equal fuel economy with much faster take-off, or are able to take off heavier loads on same length of runway.

The relatively small physical size for a given power output makes turbo-jet and turbo-prop engines of particular interest to the airplane designer. Their small size and specific weight and power characteristics offer advantages that have revolutionized the size, capacity, configuration and tactics of all military aircraft.

The turbo-jet engine became a practical device for airplane power when ways and means were evolved to use available high-temperature, high-strength alloys under conditions where controlled maximum temperatures are employed. This temperature control is obtained by burning a metered quantity of fuel in a large volume of air which, under starting conditions on the ground, is induced by a powerful rotary compressor. The compressor is a necessary component of any turbine engine, and is capable of moving and compressing tremendous quantities of air. The power driving the compressor is provided by a turbine wheel which is directly coupled to the compressor shaft. The turbine wheel is rotated by the impingement of the hot gases produced by combustion in their escape from the combustor. As the plane moves through the air, the ramming effect of air entering the compressor intake increases very materially the volume of air the compressor handles effectively. A typical practice is to supply the turbine engine with approximately 60 pounds (which is approximately 840 cubic feet) of air for each pound of fuel consumed. This amount of air provides approximately four times the amount necessary for complete combustion, the excess being necessary for internal engine cooling to control the high temperature which would otherwise destroy the engine parts.

The burning of gasoline in a cylinder of an engine or in the combustors of a gas turbine is a chemical process in which a mixture of gasoline and oxygen combine to form fuel which, when ignited, produces heat energy. The engine transforms this heat to useful power or work. Some energy losses occur in the form of heat radiation to the cooling and lubrication systems of the engine. Actually, it takes approximately 15 pounds of air mixed with one pound of gasoline to provide complete combustion. The amount of power obtained is directly proportional to the type and quantity of fuel and fuel-to-air ratio injected into the cylinder for piston type engines or into the combustor for turbine type engines.

As airplanes developed, it became apparent that operating at higher altitude was desirable, not only to get over natural obstacles such as mountains, but also from a military standpoint. Further, if one is able to dive down upon an adversary, an important tactical advantage is obtained so one must continually strive for altitude performance exceeding the enemy. To maintain the horsepower-weight ratio demonstrated at sea-level becomes an increasingly difficult problem with increased altitude.

The conventional gasoline engine depends on atmospheric pressure to induce air into its cylinders on the intake stroke of the piston, which creates a vacuum in the cylinder. When the valve is opened this vacuum causes fuel, air and gasoline, to be injected by outside atmospheric pressure.

At 10,000 feet altitude, atmospheric pressure is 74% of that at sea-level. At 20,000 feet it is 53%; at 30,000 feet it is 37%; at 40,000 feet it is 25%; and at 50,000 feet it is only 15%. In other words, if one were able to take a conventional gasoline engine providing 1000 horsepower at sea-level to 50,000 feet altitude, one would find it would not take in as much fuel and air, and due to friction, temperature and inertia losses at high altitude remaining almost as high as at sea-level, the engine would actually only produce 35 horsepower of useful work.

The exhaust and crankcase back pressures are much lower at high altitude than at sea-level which is an advantage that can be gainfully used by adapting a device called the turbo-supercharger to the engine, thereby providing an efficient method of improving high altitude performance of reciprocating engines.

The turbo-supercharger is a device in which the hot exhaust gases leaving the combustion chamber under pressure are directed through a turbine rotor, which, in turn, is coupled to the impeller of a centrifugal compressor. The latter takes atmospheric air and compresses it for charging the cylinder to a higher pressure. By proper proportioning of speed and diameter, the supercharger driven by the exhaust gases is capable of maintaining sea-level horsepower to approximately 25,000 feet of altitude.

The need for maximum power from a given displacement and for flying at higher altitudes makes it necessary to have all larger engines supercharged by a gear driven impeller. This impeller is the rotating member of a centrifugal compressor receiving its power from the engine's crankshaft as an integral part of the engine. Such supercharged engines are identified as "sealevel" engines when their horsepower ratings are determined at sealevel, because the compressor or blower, as it is commonly called, has capacity only to supply enough air to reach that horsepower rating. This type of supercharger involves the use of minimum weight and space. Its disadvantage is in lower horsepower at higher altitude, limiting use of the engine except where exhaust driven turbo-superchargers are applied to utilize the high temperature exhaust gases as they are expelled from the engine cylinder.

For various types of airplane operation, altitude rated engines are available. These engines are rated to deliver a specified horsepower output at a certain altitude, say 15,000 feet. The horsepower required to drive the supercharger becomes a handicap at take-off and for the first few thousand feet of climb, because considerable power must be expended in driving the supercharger for an altitude rated engine and at lower altitudes part of that power is wasted.

The ingenuity of the engine builder and the demands of the airplane user have provided built-in engine supercharging of many combinations to meet particular programs of airplane operation. In addition to the single-speed single-stage, there have been provided two-speed single-stage superchargers, where at some desired place in the airplane's climb, with a low speed supercharger drive, an additional gear is clutched-in to provide for high speed of the supercharger, thus increasing engine power from the cylinders. An interesting type of built-in supercharger is the variable-speed, single-stage hydraulic clutch type. Another combination of supercharging to meet particular operating conditions is two-stage supercharging and two-stage supercharging with intercooling to provide the maximum altitude for reciprocating engines when a turbo-supercharger is not desirable. The intercooling is provided by cooling the heat of compression caused by supercharging beyond the normal amount of single-stage. All of these various combinations add weight and complexity to the engine but each type has been justified for particular installations and aircraft uses.

The evolution of the reciprocating engine for aircraft work, from the Wright Brothers' flight of 1903 until 1945, had a marked influence on the increased performance of airplanes and developed knowledge of aerodynamic designs for high speeds and high altitudes. Advances in increased power output and reduced engine weight were steady, and there were satisfactory reciprocating engines in sizes up to 3000 horsepower and at weights of less than one pound per horsepower for the larger sizes. The bulk and limited maximum horsepower of reciprocating engines stood in the way of the truly high speeds that were possible aerodynamically if engine power were to be multiplied many times without adding to size and weight of the airplane. The previous forty years had explored practically every conceivable engine configuration, size and number of cylinders, pistons, valves and crankshaft arrangement. While 4-cycle engines were the general rule, 2-cycle, Diesel-cycle and barrel type squash plate and cam engines had all received some share of development.

The aircraft industry and the users of flying facilities chose the maximum in efficiency at every stage of the development; they demanded high outputs, light weight, good economy and a high degree of reliability.

During these years, the fuel refiner, the metallurgist and manufacturers of the many highly specialized components, such as steel-backed lead-bronze and silver bearings, sodium cooled exhaust valves, high-temperature high-strength alloys, automatic variable pitch and constant speed propellers, fuel metering devices, electronic controllers, etc., continued to contribute better design and products. These advancements, constructive as they were, did not indicate any method of overcoming the increas-

(Continued on Page 14)

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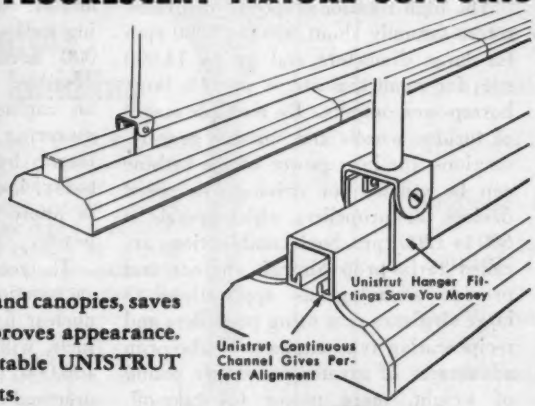

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(Continued from Page 13)

ing loss of performance inherent with increasing altitude and the consequent need for supercharging, and how to handle increasing difficulties of providing rotating propellers to effectively utilize increasing horsepowers under high altitude conditions. To double the horsepower output without increasing weight and size of the engine so that the size and shape of the airplane remained the same, continued to be a slow evolution which, if accomplished, would have increased the plane speed by 25%.

About 1935, the British and Germans began giving serious consideration to the possibility of gas turbine power plants for airplanes. The earliest interest in gas turbines for airplanes in America began around 1940. The general American pattern of gas turbine consideration was based upon regarding it as a substitute for, or alternative to, the reciprocating engine when driving a propeller. The reciprocating engine in the larger sizes was limited in engine speed to something under 3000 rpm, while turbine engines, being free of reciprocating mass weights, could operate at speeds up to 15,000 rpm in the sizes that were of interest. Such increases in speed would, of course, provide small, compact units of power with probable reduction in weight and vibration.

In 1942, turbine jet engines with 1000 pounds thrust were available and flown experimentally. With the need for increased flying speed brought about by the war, successive designs were developed rapidly so that, 10 years later, much of the military aircraft of advanced types are equipped with turbo-jet engines. The centrifugal compressor type of engine was the first to reach quantity production status. The aircraft industry had previous design and fabrication experience with engine driven superchargers and exhaust driven turbo-superchargers. Those components are really small prototypes of the impellers and casings which form the elements of the large centrifugal compressor of a turbo-jet. That experience permitted prompt evolution of the experimental jet engines of a thousand pound thrust capacity to a size providing 4000 pounds thrust. This latter size was sufficiently powerful to provide a power plant for a single engined fighter airplane with superior characteristics. Since that time the thrust output of the centrifugal compressor type engine has been materially increased, thereby providing improved airplane performance.

Paralleling the development and production of centrifugal type turbo-jet engines, the axial flow compressor type was also intensively explored. That type is particularly adaptable to streamlining of engine installations in high speed airplanes. While the axial flow turbo-jet is more complicated to manufacture than the centrifugal type, many jet engine aircraft powered with axial flow types are setting the future engineering trends for gas turbine engines for the more advanced aircraft.

The jet of a turbo-jet engine consists of a large volume of high velocity and heated air and products of combustion ejected through a specially designed nozzle of approximately 10 to 30 inches in diameter at approximately 1300 mph.

Elimination of the familiar airplane propeller plus the light weight and small size of the power plant changes the shape and appearance of the modern military airplane. The high power output of the turbine engine requires equally high consumption of fuel so the gas tank capacity for a jet plane must be materially increased or its range of operation curtailed. To provide the military airplanes with sufficient fuel capacity, extra fuel tanks are hung under wings and wing tip tanks, whether permanent or disposable, are the regular practice.

The high rotational speeds of turbine rotors (usually about 6000 to 8000 rpm for large diameters and up to 14,000 rpm for small diameters) provide large horsepower outputs. By multiple stages of turbine wheels and suitable gear reductions, the horsepower of the turbine can be utilized for driving low speed devices, like propellers, which operate at 600 to 1200 rpm. Such combinations are called turbo-prop aircraft engines and provide advantageous applications to large airplanes now using propellers and reciprocating type engines. Turbo-prop advantages of greater power per pound of weight, more power for take-off, higher aircraft speeds, smaller frontal area, minimized vibration, simpler installation and maintenance, will be realized in commercial transports as rapidly as military engine program priorities permit.

With turbo-prop engines having completed over 5 years of development and actual flight testing, preparation for quantity production of those engines and increasing the number of airplane installations are active programs. While all types of turbine engines are directed into numerous programs supplying military requirements at this time, it is not unlikely that commercial airways may, in the not too distant future, acquire turbo-propeller engine installations to meet the requirements of faster and superior transportation for the more important airline routes.

Turbo-prop engines will operate satisfactorily on kerosene and the lower octane fuels; lubricating oil consumption is also quite low. These are factors that the commercial operators will take advantage of at the earliest opportunity.

Since the advent of the gas turbine engine for the military aircraft field in 1941, and with the concentration of engineering, metallurgical and processing effort by the aircraft engine companies and aircraft plants and their respective subcontractors and suppliers, the military airplane engines now develop the equivalent of 5000 to 15000 horsepower, each, and installed engine weights are exceedingly low.

The horizon, today, shows that there are many unique materials, including fuels, that offer desirable applications for better aircraft and engines using hydrocarbon fuels. These materials and the expanding "know-how" with the steady improvement in engine design and the excellence of test facilities existing today, all combine to make a 100,000 horsepower aircraft engine unit possible. The practical aspects of such an engine are not determined by engineering and material limitations, but largely by economic practicability as of today, i. e., one would not know where to apply such a single unit of horsepower.

The rocket engine using direct chemical reaction, and the atomic engine using nuclear fission in place of hydrocarbon fuels, will probably have to exceed the 100,000 horsepower outputs to be in practical competition with "what is new" in aircraft engines in the immediate years ahead.

Rocket engines, being independent of the need of a continuous supply of oxygen from the atmosphere to furnish combustion, will provide the airplane engines that will power the devices that will travel the extremely high altitudes

where atmospheric oxygen density is insufficient for practical utilization.

Atomic aircraft engines will probably not be engineered to provide units of tremendous power output of which they appear capable, but will probably start out with nominal powers with fantastic range of operation without need of replenishing the fissionable material originally provided. The elimination of consumed fuel as an important part of the pay load of mechanical transportation has intriguing possibilities for aircraft.

Westinghouse Elects Patterson to Board

President Gwilym A. Price of Westinghouse Electric Corporation announced on Oct. 28 in New York City the election of William A. Patterson of Chicago to the Westinghouse Board of Directors. Patterson is president of United Air Lines and for many years has been a prominent leader in the air transportation industry.

Patterson is a director of United, the Air Transport Association of America, the Insurance Company of North America, the City National Bank & Trust Company of Chicago, the Stewart-Warner Corporation, the Mutual Benefit Health and Accident Association of Omaha, and the National Travelers Aid Association. He also is chairman of the Business-Education Committee of the Committee for Economic Development, a member of the Board of Trustees of Northwestern University, Evanston, Illinois, and the Museum of Science and Industry, Chicago.

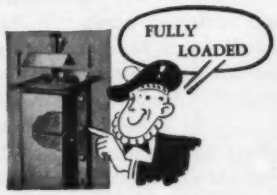
He was a banker in San Francisco before joining the Boeing Airplane Company, Seattle, as assistant to the President in 1929. He became vice president of United Air Lines in 1933 and a year later was elected its president. Under his guidance, United has grown to include service over 13,250 route miles to 78 cities coast to coast, the length of the Pacific Coast, and to Hawaii.

Titanium Facilities Are Being Expanded

Vitro Corporation of America has awarded the contract for construction of the titanium facilities being designed for Cramet Inc., at Chattanooga, Tenn., to Turner Construction Company of New York.

The new plant which will increase domestic production of titanium sponge by 6,000 tons annually, is scheduled for partial production in 1954 and full production a year later. It is being built under agreement between the General Services Agency and Cramet, a subsidiary of Crane Co. of Chicago, Ill. The major part of the titanium output will be channeled toward U.S. Air Force requirements.

Vitro Corporation is handling overall project management and engineering of the new plant under contract with Cramet. Vitro is an engineering, research and development firm specializing in the design of process plants and other technical facilities.



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The names of **Julius L. Hecht, Albert Reichmann,** and **Alf Kolflat,** members of the committee which wrote the tribute to William S. Monroe which appeared in the November, 1953 issue of Midwest Engineer, were inadvertently omitted. This omission is regretted, and the Western Society of Engineers wishes by this statement to thank the committee, and tell its members of the appreciation which the Society feels for them.

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●

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Western Society of Engineers

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Air Pollution Is Subject of Talk

The answer to air pollution is research and development, not legislation, Dr. John T. Rettaliata, MWSE, president of Illinois Institute of Technology, told a dinner meeting of the Midwest Air Pollution Prevention Association in Gary, Ind., on Oct. 15.

"The sooner the research and development programs are stepped up, the sooner we will get rid of objectionable and harmful air pollution," Dr. Rettaliata declared.

The Illinois Tech president said the passage and enforcement of antipollution legislation has been instrumental in reducing air pollution in many cities and states, but it is only a partial answer to the problem.

"It is a simple matter to pass legislation outlawing air pollution. It is a much more difficult task to actually stop objectionable and harmful air pollution without closing down many industries.

"We must strike at the core of the problem, and this can be done only through research and development. Legislation merely scratches the surface," he declared.

Dr. Rettaliata said there has been an increased interest in air pollution control as a result of such incidents as the smog which took some 20 lives in Donora, Pa., in 1948.

He said the increased interest in air pollution is reflected in the formation of civic protest groups, the passage of legislation, greater research expenditures, industrial attempts at self-control, and the activity of organizations such as MAPPA.

Those persons demanding the immediate control of air pollution, however, misunderstand the nature of the problem, according to the Chicago educator.

He pointed out that the combustion of any fuel — whether it be a solid, liquid, or gas—always results in waste products. The nature of these waste products and the manner in which they are disposed of determines whether they are objectionable or harmful, he said.

The complete elimination of air pollutants is impossible, according to Dr. Rettaliata.

"Clean air is a matter of degree," he said. "As long as there is air, there will be some air pollution. Nature and the public, as well as industry, contribute to the contamination of our atmosphere."

He said industrial concerns are spending millions of dollars each year to combat air pollution because "industry, more than anyone else, recognizes the objectionable features of air contaminants."

Dr. Rettaliata said industrial firms are trying to police themselves because "they realize the consequences if they don't." The public no longer regards air pollution as a necessary by-product of industry, he emphasized.

The City of Chicago has called upon Armour Research Foundation of Illinois Institute of Technology to assist with the fight against air pollution in two ways.

1. Through the collection and analysis of dustfall samples taken at 25 stations throughout the city.

2. Through a technical survey of industrial hazards and pollutants for the purpose of furnishing assistance in the revision of the city's zoning regulations.

"Science has been responsible in part for the contamination of air," Dr. Rettaliata said, "and science has the greatest potential for seeing that air pollution is made harmless and nonobjectionable"

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Energy of the Sun Must Be Harnessed

The energy of the sun must be harnessed if civilization is to survive, Dr. Harry E. Gunning, associate professor of chemistry at Illinois Institute of Technology, declared on Oct. 28.

He said effective utilization of the sun's energy is necessary because "our modern civilization is inextricably geared to an ever-increasing rate of depletion of our existing energy sources."

Existing sources of energy are diminishing, Dr. Gunning explained, with coal and petroleum reserves expected to last for roughly a century and uranium for about two centuries.

Dr. Gunning presented the first in a series of eight monthly lectures at Illinois Tech for high school science teachers in the Chicago area.

Dr. Gunning explained some of the research he is conducting on the problem of using the sun's energy, under the heading of photochemical reactions. These reactions, he said, are initiated by light energy. One of the reactions described was "How Ultraviolet Light Can Be Used to Separate the Isotopes of an Element," his speech topic.

One of the major objectives in this research program on the photochemically induced separation of isotopes, he said, is the development of economical methods whereby such separations can be made for elements of national significance.

Curriculum Gives Ability to Think

"The pursuit of an engineering curriculum possesses a tremendous potential for bestowing on its students the rare quality of the ability to think—to face facts, breaking through the cobwebs of emotion and prejudice to reach always an unerringly logical conclusion. The successful engineer must, above all, school himself to seek the facts, to coordinate them, and to let them direct him to the sound conclusion which, if his premises have been sound, will be immediate and obvious."

This was stated in a speech by Frederick S. Blackall, Jr., president of The American Society of Mechanical Engineers at the University of Connecticut on Oct. 22 before Pi Tau Sigma, national honorary mechanical engineering fraternity.

"Decision is perhaps the most difficult of all the tasks which face us in life. Why else is it that the man at the top of a business or institution is generally the most highly paid? Primarily, because (in spite of his many privileges) he has to make sound decisions. The types of decisions which a manager has to make are not the easy and obvious ones. They concern problems in which there are, let us say, 49 reasons why a certain course of action should not be taken, and 51 reasons why it should be. Which is the better course? Which will succeed? This sort of decision takes real thinking and the ability to evaluate.

"Cogitation is the mark of the educated man. There is ample statistical evidence that this is the case and the world recognizes it. Manual labor reaches its peak earnings at age 40; high school graduates reach theirs at age 50. The average earnings of a college graduate at age 30 equal those of the high school graduate at age 40. Furthermore, the earnings of the college graduate continue upward to his average retirement age at 65 without interruption. Over 50 per cent of the men in the highest income brackets in this country are graduates of institutions of higher learning; another 40 per cent are the high school graduates; and only eight per cent of them are grade school graduates only.

"The ability to think is something that it does not take a lifetime to develop. The human brain, as a thinking muscle, reaches its peak at age 25. From that time forward, as a physiological sinew, it begins to deteriorate, although slowly. But nature has provided experience which enables us to overcome and even surpass our waning mental ability. Experience is just another name for the integration of the memory of past mistakes.

"The man who never makes a mistake never gets anything done. Just try not to make the same mistake twice.

"Another quality which one should derive from an engineering curriculum is initiative, the habit of doing what ought to be done without being told. The man at the top has to be a self-starter. There is no one standing behind his chair to prod him if lassitude or indifference overcome his will to accomplishment. The ability to "take it"—to have faith in yourself and your ability to achieve objectives—is one of the very

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Western Society of Engineers

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fundamental elements of success in life. You can achieve almost anything in this world if you really want to. The trouble is that there is only one man in a hundred who wants to badly enough.

"A third quality which is one of the fundamentals of successful accomplishment is judgment, developed when you have practiced the power of decision long enough, and have seen the results of these decisions when put into action. This is what makes it possible for a man of experience to size up a situation and tell you what ought to be done about it (and nine times out of 10 be right) almost before you have been able to grasp the nature of the problem, or even to appraise the pros and the cons.

"One of the reasons why an engineering curriculum is such an excellent conditioner for the type of mental exercise which must constantly be indulged in by executives and adminstrators, technicians and scientists, is that engineering study by its very nature required intensive concentration. But—one caution—it may lead to overspecialization and slighting of the greater values of life. The end product may be the man who lacks broadmindedness.

"Engineers, of all people, need to guard against this sort of thing. They should make a conscious effort to cultivate breadth of mind by reading and studying in other fields, to develop other interests. Some of the great engineers of all time have also been great artists, great sculptors, great musicians, great writers. Breadth of mind, besides lending richness to life, sharpens one's perception and increases one's capacity for reaching sound judgments."

Forsee Small X-Ray Sources

Small self-contained sources of x-rays for use in industry and medicine may soon be a commercial reality as a result of work in progress at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Research efforts sponsored by the Foundation have been aimed at development of a "pocket-size" radiation source invented by Dr. Leonard Reiffel, supervisor of the Foundation's nuclear physics section.

The new x-ray source can be made in almost any size, from tiny pellets to larger blocks or sheets. Another advantage is that it is entirely self-contained. There is no bulky electronic equipment and no wiring connections as in conventional x-ray generators now used for industrial and medical purposes. The radiation emitted is essentially the same as that emitted by x-ray tubes, but is of lower intensity.

The device is potentially more flexible than the radium and radon now used in treating cancer and could conceivably be a valuable supplement to existing techniques, Reiffel said.

Radon, a gas derived from radium, produces the right kind of radiation for this work but has a very short useful life—only a few days. Radium retains its activity much longer, but it is expensive and scarce and must be removed after treatment is completed.

Reiffel's device, on the other hand, can be designed to remain active for almost any time period desired, from a few days to many years. Also, it produces only the desirable x-rays, unlike ordinary radioactive isotopes. Equally important, Reiffel said, is the fact that it is fairly inexpensive.

Foundation physicists caution that this is not a new cancer cure and that it should not be thought of as such. They emphasize that this is only one more radiation tool that should be useful in medicine as radium and conventional x-ray equipment have been useful.

Industry also should benefit from the discovery, Foundation physicists believe. X-rays now are used for inspecting vital parts, but the bulky equipment needed to produce them limits their usefulness. With the new source, this sort of examination should be easier than it now is.

"To make an x-ray picture of an airplane wing, for example, you could put the radiation source right inside the wing and place film around the outside," Reiffel said. "When you developed the film you would have an x-ray picture of the wing structure."

Somewhat similar methods are now in use employing radioactive isotopes, he added, but the pictures produced in this way are often inferior to those made with x-rays. The very penetrating rays produced by radioisotopes generally give pictures a lower contrast than can be obtained with x-rays, he explained.

The new x-ray source operates on what is known as the Bremsstrahlung principle. It consists simply of a small quantity of radioactive material surrounded by a layer of some heavy metal.

The radioactive center emits a form of energy known as Beta rays, which consist of high energy electrons. These electrons drive out through the atoms in the surrounding heavy metal. In doing so, they are deflected from straight line paths through the metal, and this change in direction produces the form of energy known as x-rays.

Quantity and quality of x-ray energy coming out of this Beta ray to x-ray converter can be regulated by varying the core material and the thickness and composition of the shell.

"This type of x-ray source promises to be a versatile device," Reiffel said. "It is very easy to turn the radiation off by removing the heavy metal shell and replacing it with a sheath of plastic that absorbs Beta rays without forming x-rays." This is not possible with ordinary radioisotopes, he pointed out.

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WSE Applications

In accordance with the By-Laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office. The Secretary's office is located at 84 East Randolph Street. The telephone number is RAndolph 6-1736.

50-53 Gene R. Farringer, Drafting, DeLeuw, Cather & Co., 150 N. Wacker Dr.

51-53 Miss Margaret M. Hebel, Draftswoman, DeLeuw, Cather & Co., 150 N. Wacker Dr.

52-53 William R. Dangremond, Junior Engineer, Inland Steel Container Corp., 6532 S. Menard Av.

53-53 Otto C. Krolopp, Mechanical Engineer, Petersen Oven Co., 9900 W. Franklin Av., Franklin Park, Ill.

54-53 Robert C. Kenan, Assistant District Sales Manager, Koppers Co., Tar Prod. Div., 122 S. Michigan Av.

55-53 F. W. Madison, Structural Engineer, DeLeuw, Cather & Co., 150 N. Wacker Dr.

56-53 Oscar Stiska, Chief Draftsman, R. C. Mahon Co., 231 S. LaSalle St.

57-53 Frank M. Scott, Heavy Indust'l. Equip. Specialist, Allis-Chalmers Mfg. Co., Midwest Region, 135 S. LaSalle St.

58-53 Irving L. Hertzman, Appraiser, Irvin Jacobs & Co., 105 S. LaSalle St.

59-53 George W. Duwel, Jr., Field Engineer, Fairbanks Morse & Co., 1550 S. State St.

60-53 George Wight, Civil Engineer, Wight & Co., 1036 Curtiss St., Downers Grove, Ill.

61-53 John S. Carter, Junior Design Engineer & Estimator, American Bridge Div., U.S.S. Corp.

62-53 William M. McClurg (Rein.), Partner, McClurg, Shoemaker & McClurg, 39 S. LaSalle St.

63-53 James R. Sherretz, Resident Engineer, Grade III, DeLeuw, Cather & Co., 150 N. Wacker Dr.

64-53 John E. Heald, Field Engineer (Ch. of Party), DeLeuw, Cather & Co., 150 N. Wacker Dr.

65-53 Robert H. Clore, Technical Service Manager, Universal Atlas Cement Co., 208 S. LaSalle St.

66-53 Merle W. Tellekson, Party Chief, DeLeuw, Cather & Co., 150 N. Wacker Dr.

67-53 Harry H. McMeen, Partner, Sargent & Lundy, 140 S. Dearborn St.

Construction Men Active in Defense

Construction men, from contractors to laborers, are the center of many local civil defense programs underway today, according to Engineering News-Record, McGraw-Hill publication.

While civil defense in general has lagged because of public apathy and lack of funds, construction men are taking a surprisingly active part in such preparations for disaster, the magazine says.

Most municipal programs, even those in low gear, include an inventory of construction equipment available, a mobilization plan for construction workers and supervisory personnel and active participation of local chapters of the Associated General Contractors, trade unions and professional engineer societies, the magazine reports after a survey of civil defense activities in 25 cities.

Construction's civil defense mission generally is established in conjunction with the municipal public works department which usually maintains the equipment inventories and manpower rosters, and is in charge of the mobilization procedures.

In St. Louis, for example, it is estimated that construction firms would make available 18,500 men, of whom 500 would be managerial personnel, 12,000 skilled and 6,000 unskilled workers. Drills have been held there at contractors' expense.

Local chapters of the Associated General Contractors line up support of member firms in their areas and in some cases, sponsor exercises to test systems of summoning contractors and their equipment to assembly areas.

Building trades unions also are active in recruiting and, in some places, are taking a hand in training. In Salt Lake

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City, for example, they're putting up ten "open sets" to be used for practice in shoring up various types of collapsed buildings for rescue work, the magazine says.

In Milwaukee, building trades have volunteered to set up typical examples of collapsed structures and demonstrate tunneling methods for use in rescue work.

Six hundred Boston contractors and their employees are committed to report to assembly areas designated by the city building department. In Detroit, the mobilization plan involves 10,000 men, and out-of-town contractors are committed to augment the city's construction manpower by 20,000.

All contractors in San Francisco have been briefed, their equipment assigned to posts and members of the building trades council, metal trades council and longshoremen have been asked to volunteer for leadership courses.

Civil Engineers Meet for Giving of Papers

The men who are constantly rebuilding the world gathered on Oct. 17 in New York City at the annual meeting of the American Society of Civil Engineers, for a five-day presentation of papers on many accomplished and prospective achievements vital to the advancement of civilization. It was one of the most comprehensive accumulations of authoritative discussions, of major importance from both engineering and public standpoints, in the 102-year-old history of the Society.

Ralph A. Tudor, under secretary of the Interior and a member of ASCE, was the convention's principal speaker.

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Blackall Speaks at Conference

While European manufacturers of durable goods are rapidly reaching the point where they can make an effective invasion on our domestic markets, this country must increase productivity by developing and applying the best possible tools for production. Frederick S. Blackall, Jr., president and treasurer, Taft-Peirce Manufacturing Company, Woonsocket, Rhode Island, and president of The American Society of Mechanical Engineers, made this statement in Cleveland on Oct. 14 before the American Institute of Electrical Engineers Conference on Machine Tools.

Improved design and cost reduction are paramount obligations to maintain industrial leadership, he told the engineers' group. "The benefits of the joint standards developed by our engineering societies, in cost reduction, simplification, improved design and interchangeability of product, not to mention their great gifts to public safety and the national defense, are immeasurable," he said, warning, "It is important that standards be drawn in such a manner that they will be a boom to all, and not devised to meet the needs of only one specialized group or another, no matter how important or powerful."

Blackall deplored the "present duality of electrical standards in the machine tool field due to the parallel development of Electrical Standards by the Joint Industry Conference and National Machine Tool Builders Association." He called on technical staffs of machine tool consumers and machine tool builders to join in eliminating this situation which is wasteful and costly to builder and consumer alike.

"I often wonder if there is not, on occasion, too much of a technical and theoretical bias in the establishment of certain standards, and a callous disregard for the dollar sign. The manufacturer is impelled to produce the optimum result at the lowest possible price. It seems wasteful to him to demand two or three hundred dollars extra from his customer in order to provide electrical apparatus which will do the same job—in a different manner, but in most cases no more safely, not as conveniently, and no better.

"The influence of the automotive industry on machine tool design has been great and constructive, but in catering to this important customer, many machine tool builders have rather gone off the deep end in emphasizing massiveness, a multiplicity of controls, and a degree of automaticity which is practicable only in the mass production industries. The automobile manufacturer has demanded these changes for his particular purposes. The error has been in the assumption that what is necessary to automotive production will probably be suitable for everybody else," he stated.

"A tremendous field is open to the machine tool builder and to the electrical supplier in simplifying the design of general purpose tools. There are a great many operations, even within the mass production industries, which can be performed just as rapidly on a general-purpose machine tool as they can on one of the more complex models. In such cases, many of the more expensive features simply are not used, but they have to be paid for," Blackall pointed out.

"There is, of course, a place for the machine tool which is the ultimate in

(Continued on Page 22)

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(Continued from Page 21)

ruggedness, high speed, variety of special features, and automatic controls; but there is also an equally important place for the general-purpose machine tool, designed for average conditions.

"In standardization and fundamental design, engineers should recognize that conformity to generally accepted principles should be the servant and not the master of creativeness and invention," he said.

Crerar Library

News and Notes

Rose Mittelmann, Research Assistant in Research Information Service, addressed the Chicago chapter of Sigma Delta Epsilon on October 21 on the subject, "Paper Partition Chromatography." She was asked to speak on this subject because she was present when partition chromatography was first developed by Martin and Synge. Dr. Mittelmann later worked with Martin on the quantitative aspects of paper partition chromatography. The discovery was awarded the Nobel Prize in chemistry in 1952.

* * *

"For Economy in Research" has been one of the most requested brochures issued by the Library. Describing the services of Research Information Service, it has recently been issued in a revised edition which pictures the over-all resources of the Library behind this unique service to industry. Since 1947 more than 1,100 library research projects have been completed, under contract with over 250 companies, government agencies and educational institutions, distributed from New England to the Pacific Coast, in 26 states and the District of Columbia. The many scientific organizations occupying quarters in 84 and 86 East Randolph Street are listed in the brochure, which will be sent to interested persons without charge.

* * *

A recent tabulation of statistics compiled by Photoduplication Service shows the continuing demand for copies of books and articles in the collections. From January through September of this year, 48,401 photostat and 12,709 microfilm exposures were processed, representing increases of 44.3% and 179% over the corresponding periods in 1952 and 1951, respectively. 196 organizations have had Type A coupons on deposit at the Library, against which they may charge orders; 99 others have purchased Type B coupons which are mailed in to obtain photocopies.

Radioactive Silver May Measure Film

Measuring and controlling the amount of silver in photographic film emulsions during the manufacturing process should be possible by using radioactive silver, according to scientists at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Once a laboratory curiosity, radioactivity is now ready to help out in many industrial jobs, including the manufacture of photographic film, it was pointed out by Leonard Reiffel, supervisor of the Foundation's Nuclear Physics section.

The trick is done by making some of the silver atoms in an emulsion batch radioactive. Instruments then can detect and measure radiation from the emulsion as the film is manufactured. Because only a very small number of atoms need be made radioactive, the method does not harm the film in any way.

Describing what can be done, Reiffel said that the silver in a small sample of emulsion can be measured to 0.1 percent accuracy in about three minutes. It also is possible to measure the amount of silver in sheet film as it comes from the production line at a rate of one foot a second. Reiffel believes this method can give production control to an accuracy of 2 to 5 percent in the emulsion thickness.

Armour Research Foundation scientists agree that these methods and others involving radioactivity offer solutions to many photographic-material manufacturing problems as well as other industrial problems.

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On Training—
Letters from Leaders

In the last issue of Midwest Engineer we published another of about thirty letters received from leaders of Chicago-area firms concerning shortcomings noted in the engineers in their employ. Many of the letters also suggested what the engineers should do to correct their deficiencies.

Significantly, the engineer's technical training is generally considered adequate. In the broad area of Human Relations, however, engineers seem often to be "under achievers," according to the viewpoint of the industrial leaders as reflected in their letters.

We are printing another of these letters in this issue, as we shall do in future issues. Although the letters may be of greatest value to the younger engineers, we hope that all of the engineers who read them will benefit.

Here, then, is the next letter:

Dear Mr. Becker:

Your letter of August 31 requesting our viewpoint with respect to deficiencies of engineers has been given very careful study by our—management. Herewith is their summary in answer to your question.

(1) Their general attitude and thinking are not fully oriented toward management.
(2) They are prone to want the Company to hand them security rather than to earn security through outstanding performance.
(3) They lack practical industrial experience, particularly in their own field.
(4) They are not sufficiently grounded in drafting.
(5) They are unwilling to take time to learn and think that a degree should automatically cause rapid progress.
(6) They do not really understand the basic principles of economics and free enterprise.
(7) They are lacking in understanding of human relations.

It should be noted that there is some overlapping among the above-noted items and that certain items likely stem from a common cause. It should also be noted that those Engineers who have progressed in our organization have been able to successfully compensate for most of the deficiencies.

We trust this information will be of some assistance to you.

Very truly yours,

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The United States is the principal consumer of the six precious metals of the platinum group. This country's annual platinum metals requirements in recent years have amounted to about two-thirds of the world's production.

This information, plus other data concerning the platinum metals, is presented in a continuing exhibit which was officially opened in Philadelphia on Nov. 18 at The Franklin Institute. The exhibit, called "Platinum Metals—Man's Versatile Servants," coincides with the 150th anniversary of the announcement of the discovery of palladium, which was the first of a rapid series of discoveries and developments that constituted the foundations of the modern platinum metals industry. Platinum and palladium are the most important metals of the platinum group; the others are iridium, rhodium, ruthenium and osmium.

Gustafson Is Head Of Luncheon Group

H. W. Gustafson, Phillips Petroleum Co. is the chairman of the Wednesday Noon Luncheon committee. The committee is made up of the program chairmen of the various sections of the Society.

Members of the committee, section, and dates are:

Dec. 2, 1953, Mech. .. C. H. Hubbell
Dec. 9, C.&M. ..... H. P. Hagedorn
Dec. 16, B.&S. ..... J. F. Parmer
Jan. 6, 1954, Jun. Div. .. Burd Hikes
Jan. 13, F.P.&S.E. .... C. O. Bernard
Jan. 20, Trans. ..... G. Krambles
Jan. 27, Elect. ..... C. E. Giller
Feb. 3, G.F.&C. ... H. W. Gustafson
Feb. 10, H.S.&M. ..... C. J. McLean
Feb. 17, T.E.&C.P. .... G. L. Jackson
Feb. 24, Commun. .. F. G. Varenhorst
March 3, Women's .. E. C. Liewehr
March 10, C.&M. ... H. P. Hagedorn
March 17, Mech. .... C. H. Hubbell
March 24, B.&S. ..... J. F. Parmer
March 31, Jun. Div. .... Burd Hikes
April 7, F.P.&S.E. .... C. O. Bernard
April 14, Transp. ..... G. Krambles
April 21, Elect. ..... C. E. Giller
April 28, H.S.&M. .. H. W. Gustafson
May 5, G.F.&C. ..... C. J. McLean
May 12, T.E.&C.P. .... G. L. Jackson
May 19, Commun. .. F. G. Varenhorst
May 26, Women's ..... E. C. Liewehr

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WSE Personals

W. E. Mahin, MWSE, has just written the Western Society a letter, parts of which we quote here:

"Now that I have finally become more or less settled here in Cambridge, I can bring you up to date on developments since I wrote you of my resignation from Armour Research Foundation last March.

"Mrs. Mahin and I thoroughly enjoyed our month-long tour: through the Southwest, up the west coast as far as Portland, and back to Chicago by way of Denver. We spent about ten days in and around San Francisco while Professor Chuck Barrett of the University of Chicago and I did some consulting with the staff at the University of California in Berkeley for the Ship Steels Committee of the National Academy of Sciences. Naturally, Berkeley is a rather nice spot for such activities.

"Upon returning to Chicago, I continued my work with Dr. Barrett at the university until late July, at which time, I assumed my new position (of technical director) with the Vanadium Corporation of America (Cambridge, Ohio).

"Naturally, it has been an interesting experience for me to return to the company for which I worked eight of my early years, but left back in 1936. At Cambridge, we are establishing a new Research Center, the first building of which, a million-dollar, very modern, air-conditioned research laboratory, is about three-quarters completed."

Carl L. Gardner announced the establishment of the city planning firm of Carl L. Gardner and Associates, one North La Salle st., Chicago 2. The telephone number is ANdover 3-6350.

Soil Testing Service, Inc. announces the appointment of Robert L. Reisinger, Jr. to head the firm's operations in Wisconsin, Minnesota, and Upper Michigan. Reisinger, a civil engineer, was formerly associated with Ammann and Whitney, consulting engineers of Milwaukee and New York and replaces Robert Novak who has been assigned to direct the firm's operations in the north central United States and is now working from their Chicago office.

Edward G. Schnetzler, MWSE, is now division dial coordinator of the Illinois Bell Telephone Co.

Dr. John T. Rettaliata, MWSE, president of Illinois Institute of Technology, was presented with the annual Colombo Award of the Italian-American Civic club of Maryland. He received it Oct. 11, Columbus Day eve.

Frank W. Snow, MWSE, retired on Sept. 1 from the Otis Elevator Co. where he had been a sales engineer, and moved to Mt. Holly, N. J.

E. F. Langhenry, AWSE, formerly sales engineer, Rockbestos Products Corp., is now associated with Erico Products, Inc. The company manufactures quick connectors, holders, ground clamps, etc.

Russell M. Butler, MWSE, formerly piping checker with A. J. Boynton & Co., Chicago, is now associated with Monsanto Chemical Company of St. Louis, Mo., in St. Louis, in the Organic Chemicals Division Engineering Department.

Theodore W. Van Zelst, MWSE, of Soiltest, Inc., attended the meetings of the Third International Conference on Soil Mechanics and Foundation Engineering held at Zurich, Switzerland in late August. While in Europe he also visited his firm's sales representatives in Portugal, Spain, Italy, Switzerland, and Belgium.

Richard G. Fencl, MWSE, president, Midwest Section of the Institute of Traffic Engineers, was the Tuesday noon speaker, Nov. 3, at the Sixth Annual Illinois Traffic Engineering Conference at Urbana, Ill.

John D. Armstrong, AWSE, formerly with Peterson Oven Co., is now with Beling Engineering Consultants in Moline, Ill.

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Exploding Dynamite Makes Not a Sound

If dynamite is set off in the middle of an uninhabited area, is there no noise because the explosion is not heard by anyone?

A. P. Fugill of the Detroit Edison Company answered that riddle on Oct. 24 at the National Noise Abatement Symposium, at Armour Research Foundation of Illinois Institute of Technology, for Chicago.

"Noise," said Fugill, "is a wave motion which becomes noise only when it causes the human ear to respond in the peculiar manner we refer to as hearing."

Fugill spoke of the problems which arise when an industry finds itself in a residential section. "There are people who insist on living close to industrial sites, who, nevertheless, object to excessive noise. Therefore, industry is forced to satisfy the community's reasonable requests for satisfactory living conditions."

Industry, much like the riddle, often tries to move into unoccupied territory . . . take the noise away from the people. "But," said Fugill, "a residential neighborhood seems to spring up magically almost at the property line of the industrial plant."

Fugill said the problems of reducing industrial noise were once believed insurmountable but that great strides had been taken towards the satisfactory solution of the situation.

He explained how his organization, Detroit Edison, had met and partially solved its residential noise complaints.

He concluded there are many cases where reduction of noise in plants can be effected at little cost. In the construction of new plants, he advised careful consideration of the noise factor from the early stages of design. He offered decentralization as a possible solution in some cases.

"The problem is not insolvable, but requires clear thinking and cooperation on all sides. Industry cannot exist without the community in which it is located and the community cannot be economically healthy without industry."

Underground Airway Drilled Through Rock

An underground airway which will funnel fresh air to workings almost a mile below surface is being driven through solid rock at the Creighton Mine of The International Nickel Company of Canada, Limited, in the Sudbury District of Ontario, it was announced at Copper Cliff, Ont. on Nov. 19.

Designed to serve the famous Creighton from 58 to 64 levels with 350,000 cubic feet of air per minute, the new airway is 13 feet in diameter, driving through 600 feet of solid rock. It fits into the mine's elaborate ventilation system of which the main intake fan is located on 40 level and the main exhaust fan on 30 level.

A portion of the airway is being partitioned off with corrugated iron sheeting to serve as a continuation of the mine's safety manway to surface, and also to carry the pipelines in which sand fill will be sent down from surface to replace ore taken from the stopes when mining gets underway.

An innovation at Inco is the special construction method by which the big air shaft is being installed. A pilot raise, 7 by 11 feet, is first driven upwards in 200-foot sections by regular mining technique. Then, working from the top down, each section of the pilot raise is widened to the dimensions of the circular airway, 13 feet 6 inches in diameter, and is concreted.

Widening and concreting operations are carried on from a platform suspended on four sets of chains from eye bolts driven into a finished "lift" of the airway wall. Working from the platform, miners start the construction cycle by drilling off and loading a circular 10-foot bench which will round out the rectangular opening of the pilot raise. The platform is pulled up during blasting; the broken rock drops down the pilot raise and is trammed away on the level below.

When the platform is returned to working position after a blast, and scaling for loose has been done, holes are drilled for the steel pins to support the cylindrical sectional steel forms for the next pour of concrete. The forms are lowered, blocked and braced to the bench, and lined up. Hitch boxes are set in to leave openings for the steel dividers supporting the manway platforms and partition, and all is then in readiness for the pour. A connection is made to the concrete pour pipe which has been carried down in the manway compartment as construction of the airway progressed, and concrete is poured by gravity flow from the mixing station located up on 56 level.

While the 10-foot "lift" is setting, another round is being drilled off.

At each level of the mine a concreted station is being established in which ventilation system controls for the airway will be located.

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RECEPTIONISTS CORNER

During the month of December the offices of Engineering Societies Personnel Service will be in their new quarters on the sixth floor of the Western Society of Engineers building. All visitors will be welcome to come in at any time during the month of December. Our address is still 84 E. Randolph Street, and our own phone number of STate 2-2748 will be in effect again.

We wish all of you a very Merry Christmas and the Happiest New Year ever.

J. H.

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D-8930 ENGINEER AND ARCHITECT—Sanitary Engr. CE Age: 35 and older with responsibility design exper. in sewage treatment, plants of 10 mill. gas per day capacity. Company will pay fee. Salary range $10,000. Location: Midwest.

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C-1425 SALES ENGINEERING SERVICE—Age: 40-50. 5 plus yrs. exp. in sales or application work in sanitary, waterworks, and/or gas utilities. Duties: sales promotion and administrative work on engineering service in sanitary, water works, etc., field and contacting industrials and municipalities. For a firm of consultants. Salary: $6000-$8000 per year. Employer will negotiate fee. Location: Chicago.

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C-1428 MECHANICAL RESEARCH—ME or better. 5 plus yrs. exp. research and development of machinery, mechanisms or structures. Duties: research work. Salary: open. Location: Western Chicago suburb.

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Plant Many Trees For Each Baby Born

For every baby born in the United States — one every eight seconds—at least 128 tree seedlings are planted as extra assurance that there will be enough lumber and other forest products for future housing needs and other requirements.

And these planted seedlings are an incalculably small fraction of those springing to life which will survive to maturity through natural reforestation, according to A. Z. Nelson, forest economist of the National Lumber Manufacturers Association.

"Houses are built at the rate of a million or more a year," Nelson said. "If harvested all at once, our present standing timber volume would be sufficient to build 160 million six-room houses—or one house for every man, woman and child in the country.

"But houses are not all built at once and timber keeps on growing. Both the rate of natural reforestation and of tree planting are increasing and will continue to increase as programs now under way bear fruit. Also, more of the tree is being used today than ever before."

More than 460 million acres are in commercial forest land, and this is enough to produce on a continuing crop basis all the wood the nation will probably ever need, according to Nelson.

Standing timber volume in 1945 on this acreage was one trillion six hundred billion board feet. However, more recent estimates in a number of states indicate a considerably larger volume.

"If saw timber stopped growing tomorrow and if we utilized all the existing supply for lumber only, our present volume would serve to supply the United States for 40 years with the same amount of lumber as was produced in the all-time record housing year of 1950," Nelson said. "In that year, 1,396,000 units were put under construction and lumber production was nearly 39 billion board feet. Of course timber will not stop growing, and we do require a great volume of products from saw timber size trees other than lumber, but this illustration helps us visualize the extent of our present timber resources.

"Four out of every five homes are built of wood, and the remainder use wood to some extent. The major part of all lumber produced goes in one form or another into building construction, and the biggest share of this is taken by home building.

"Altogether, the outlook for an ample supply of the nation's No. 1 home-building material is a bright one far into the future. We are fortunate to have a building material that can be grown like a crop and renewed indefinitely."

WSE Gets Invitation

All members of the Western Society of Engineers are invited to the Annual Holiday-Season Open House of the Building Construction Employers' Association of Chicago, complimentary to Chicago engineers and architects, on Wed., Dec. 9th from 4:30 to 7 p.m.

The editorial below which appeared in the Bulletin of the Western Society of Engineers, was quite appropriate in 1941. It is even more appropriate today.

BULLETIN OF THE
WESTERN SOCIETY OF ENGINEERS

Vol. 12 May 15, 1941 No. 20

BEQUESTS

In the seven decades which have passed since the Western Society was founded, it has served members numbering in the thousands. Many of them have been associated with the Society for long periods, sometimes throughout much of their professional careers.

Because of eminent service and long association, the Western Society has won the high esteem and regard of many who have given it loyal support during their active lives.

It is to be regretted, however, that the Society has not been the recipient of more bequests. Had such a custom been established in the earlier years, the Society might perhaps be enjoying a much larger niche in the community today. It might well be giving a vastly broader and better service.

Bequests might be made to:

The general fund or surplus. This is the Society's anchor to windward. The income from this fund is used for current operations.

An "extraordinary expense" capital fund. The J. Waldo Smith fund is of this type. The income from this fund has been extremely helpful in meeting exceptional needs.

A "special purpose" bequest, either the fund or the income to be directed to some specified objective. The Washington Award fund, donated by John W. Alvord, and the Octave Chanute Medal fund, established by Octave Chanute, are examples of this type.

A "betterment" fund, subject to such uses as the Board of Direction may consider most beneficial to the Society.

These are but suggestions. The prime purpose is to submit the thought that, through a modest bequest to the Western Society, an engineer may find a worthy medium for contribution to his profession and, through it, to his community.

Reviews of Technical Books

Automatic Controls

Principles of Automatic Controls, by Floyd E. Nixon, Prentice-Hall, Inc., New York, N.Y. First Edition, 1953. 409 pages. $9.35.

This book was written with the object of giving the reader a complete understanding of the various principles utilized in the design of an automatic control system. Background material for an understanding of this book would include the calculus, sophomore physics, and an elementary course in electrical circuits.

After the introductory chapter on automatic control systems, where applications and analysis techniques are discussed, a chapter on mathematical applications to control systems is given.

A complete chapter is given to a discussion of the Laplace transform and its application to the solution of problems. This is followed by a presentation of material on the block diagram.

The Nyquist criterion is presented in a chapter, followed by another on its application to open-loop transfer functions.

Material ordinarily discussed in the usual book on this subject, such as frequency and transient response methods, stability criteria, proper gain adjustment, compensating methods, and the effect of noise and extraneous inputs, are considered in the first part of the book. Additional techniques and tools necessary for the designer, which are numerical integration, automatic computers, methods for analyzing transient response data, and nonlinear systems.

In the appendices material will be found on the Runge-Kutta numerical integration method, methods for finding roots of equations, design data for cascaded functions, derivation of the Nyquist criterion and Laplace transform operations and pairs.

Numerous problems throughout add to the desirability of this book in which the subject material is well presented.

Electrical Engineering

Foundations of Electrical Engineering, Vol. I, by H. Cotton and E. W. Golding, Pitman and Sons, Ltd., London, 1952. 301 pages. 20 shillings.

This book is an elementary treatise on the electric circuit and operating principles of electrical machinery.

An introductory chapter on units is followed by treatment of Ohm's law applied to direct current circuits. Then resistance and the effect of temperature on resistance, conductors and insulators and measurement of resistance are discussed.

Chapters on electrostatics, electromagnetism and the magnetization of iron and steel are presented, followed by a discussion of the dynamo, direct current generators, direct current motors, and direct current measuring instruments.

Chemical effects of an electric current precedes a short chapter on elementary, alternating-current circuits, followed by a discussion of the elementary principles of illumination.

The magnetic circuit is discussed with more advanced work on direct-current generators and direct-current motors.

Finally, material on the distribution of power, the operation of direct-current generators, and the testing of direct-current machines is presented before a final chapter on advanced illumination.

It would seem that a better arrangement of the book would be a complete discussion of one topic, with the advanced material included before proceeding to another. Certainly, in the case of illumination, no material was introduced after the elementary discussion of illumination that would be necessary for the discussion of the more advanced material on illumination.

A first course in physics, plus elementary mathematics, is sufficient to study the topics covered.

Thermodynamics

Engineering Thermodynamics, by Byron E. Short, Harry L. Kent, Jr., and Burnett F. Treat, Harper & Brothers, New York, N.Y. First Edition, 1953. 467 pages. $6.00.

This book was written as a text for the first course in thermodynamics. The order of presentation of the topics varies somewhat from the major number of texts in thermodynamics written for the same purpose.

The usual introductory chapter considers fundamentals and is followed by energy transformation principles which includes the discussion on the first and second laws of thermodynamics.

Thermodynamic properties and the general theory of processes for pure substances are considered before any particular substance is treated. This is followed by a discussion of properties and processes of liquids and then perfect gases.

Mixtures of fluids and problems of flow precede the discussion of combustion. A chapter on heat transmission which usually is presented at the close of the subject is included before the material on cycle analysis which leads to compression of gases and vapors, and then material on internal combustion engines and the gas turbine.

A chapter is then included on vapor cycles, followed by material on steam and vapor turbines. The final material is on refrigeration and air cooling.

According to the authors, the order of presentation of the material has given the best results in teaching throughout a number of years. The many problems at the end of each chapter should be valuable to the student of thermodynamics in his learning process. Although this book was written primarily as a text, it may be used for review purposes by the engineer who wishes to refresh his memory on the subject. The material is well presented.

R.G.O., W.S.E.

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Harris Dedicates Ipatieff Labs

The Super Pressures unit of the Ipatieff Catalytic and High Pressure Laboratories at Northwestern University was dedicated the evening of November 20 on the Evanston, Ill., campus.

The dedication was the highlight of a joint meeting of the Chicago section of the American Chemical Society and the chemistry department of Northwestern University.

David W. Harris, MWSE, president of Universal Oil Products Co., with which the late Prof. V. N. Ipatieff was associated for more than 20 years, gave the dedicatory address.

Sir Hugh S. Taylor, dean of Princeton University's graduate school, was the featured speaker, talking on "Fifty Years of Contact Catalysis." Prof. Robert K. Summerbell, former chairman of Northwestern's chemistry department, discussed "Ipatieff at Northwestern."

The new Super Pressures unit, which took five years to plan, design, and build, is the only one of its kind at a North American university. It is located adjacent to the Northwestern Institute of Technology, which houses the Ipatieff Laboratories.

Undergraduate and graduate students, as well as scientists from all over the world, will have the opportunity in the new unit to study and do research on the application of super pressures to catalytic reactions of organic compounds. Prof. Ipatieff gained world fame for his studies and research in high pressures and catalysis. Prof. Herman Pines, longtime associate of Prof. Ipatieff both at Universal Oil Products Co. and Northwestern, is carrying on the work of his mentor as director of the laboratories which bear the name of the famed petroleum scientist.

Experiments in the new unit will be carried on behind three-eighths inch thick steel armor plate as a safety measure to scientists working with equipment which develops up to 25,000 pounds pressure per square inch. Instrument dials are visible through one-inch thick bullet proof glass. All controls for equipment have been installed outside the armor plate. Windows are protected by a thick steel mesh and are so constructed that they will "fold" outward in the event of an explosion. The latest automatic control devices also have been installed.

Reactions will be effected in flow type high pressure equipment in the main part of the new unit. Experiments will be carried out at one end of the laboratory in autoclaves, whose principle is somewhat similar to that of a housewife's pressure cooker. Investigations of new chemical reactions will be carried on in these autoclaves at temperatures up to 1,000 degrees Fahrenheit and at pressures up to 25,000 pounds per square inch.

One of the features of the new unit is a spring suspended compressor capable of building up pressure to 25,000 pounds. Weighing about 20 tons, the compressor is suspended on giant springs so that no part of the equipment touches any part of the building, thus eliminating the chance that vibrations would interfere with experiments. The compressor will be used to compress gases such as hydrogen, carbon monoxide and others used in high pressure catalytic study and research.

Another important feature of the new laboratory is a liquid pump capable of pumping liquids up to 25,000 pounds pressure per square inch.

Most of the equipment installed in the new unit was not available on the open market. Personnel of Northwestern's chemistry department machine shop fabricated the equipment, including the armor plate, controls and some of the safety devices. Many of the designs for the new addition were furnished by Universal Oil Products Co.

To Give Food Course

Courses in food engineering—the application of science and engineering to processing, handling and packaging of food—will be offered to evening students at Illinois Institute of Technology, Chicago, for the first time during the second semester.

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Natural Gas Substitute Soon to Be Available

An acceptable substitute for natural gas may be available late in 1954 or early in 1955, according to Capt. E. S. Pettyjohn, MWSE, vice president and director of the Institute of Gas Technology at Illinois Institute of Technology, Chicago.

Capt. Pettyjohn reported on the progress in the search for a natural gas substitute and other research projects in his annual report to 100 persons attending the 12th annual meeting of members and trustees of the Gas Institute at the Park Plaza hotel in St. Louis on Oct. 27.

He said the last year marked "the first time a conversion to gas has been accomplished without a solid or liquid residue resulting in the operation."

"This was performed," he explained, "by a new process of pressure hydrogasification which allowed the Gas Institute to produce a completely interchangeable natural gas substitute from natural gasoline with complete conversion of the gasoline to gas."

In outlining the advances being made in natural gas research, Capt. Pettyjohn pointed out that much remains to be done before a suitable substitute is developed for natural gas. The Institute, he added, has been working on the project since 1947.

He emphasized the importance of finding a workable substitute with the increasing and abnormal demands for natural gas due to the weather.

Capt. Pettyjohn said new research planned for the coming year includes (1) a fundamental study of the combustion characteristics and radiant heat transfer in open flames and (2) a study of the storage of hydrocarbons for peak loads.

He explained projects were conducted during the last year on the autohydrogenation of high Btu oil gas to improve its substitutability for natural gas and a study of the kinetics of the carbon, oxygen and steam system.

Dr. John T. Rettaliata, president of the Gas Institute and Illinois Institute of Technology, spoke briefly and introduced Capt. Pettyjohn. F. H. Lerch, Jr., chairman of the Gas Institute's board of trustees and director of the Consolidated Natural Gas Company, New York, gave the welcoming address.

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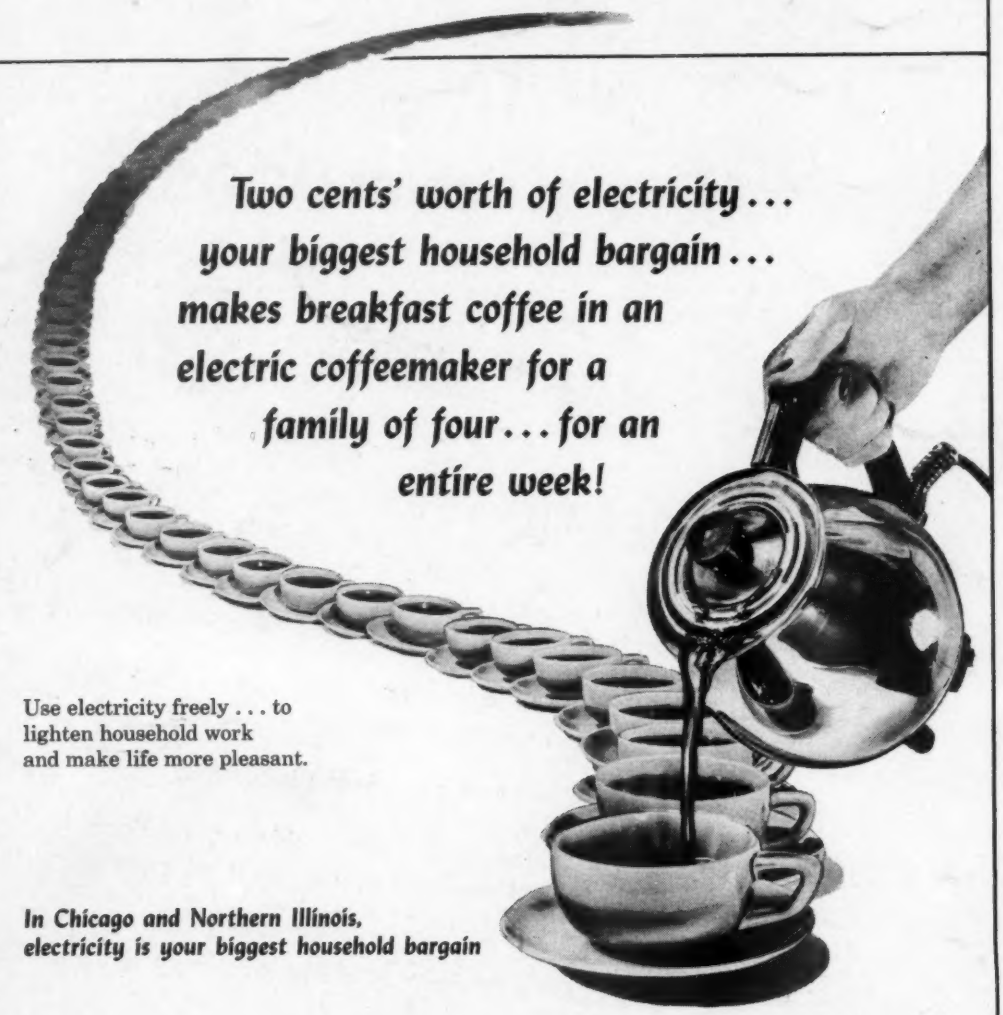

Two cents' worth of electricity... your biggest household bargain... makes breakfast coffee in an electric coffeemaker for a family of four... for an entire week!

Use electricity freely . . . to lighten household work and make life more pleasant.

In Chicago and Northern Illinois, electricity is your biggest household bargain

COMMONWEALTH EDISON COMPANY

PUBLIC SERVICE COMPANY